



**US Army Corps
of Engineers®**



Limited Visual Dam Safety Inspections

OA00019

Opaepa 02 Reservoir

Oahu, Hawaii

Prepared by:

**U.S. ARMY CORPS OF ENGINEERS
HONOLULU DISTRICT**

**STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES**

May 2006

Limited Visual Dam Safety Inspection Conducted on: 04 April 2006

I. Purpose:

Due to disaster occurrences of periodic heavy rains and flooding, which has caused extensive damage to property and loss of lives, the Governor has issued a State of Emergency Proclamation extending from February 20, 2006 to April 9, 2006. In light of the tragic failure of the Kaloko dam on Kauai and the continued forecast of heavy rains, emergency inspections of all regulated dams in all counties are being undertaken.

These inspections are for the purpose of determining if any of the regulated dams and reservoirs in the City and County of Honolulu, Maui County or Hawaii County, are suspect for immediate concern to the downstream area under the prolonged conditions of heavy rain showers.

II. Authority

Inspections were authorized under the Hawaii Dam Safety Act of 1987, Chapter 179D "Dams and Reservoirs" of Hawaii Revised Statutes, and Title 13, Subtitle 7, Chapter 190, "Dams and Reservoirs" of the Hawaii Administrative Rules.

These inspections were conducted under joint agreements of the U.S. Army Corps of Engineers (ACE), the U.S. Department of Agriculture Natural Resources Conservation Service (NRCS), and the State of Hawaii. The Memorandum of Agreement with the U.S. Army Corps of Engineers is entered into pursuant to 10 U.S.C. § 3036(d)(2), and the Intergovernmental Cooperation Act (31 U.S.C. §6505), and established via support agreement number DL-06-01.

III. Scope

Visual inspection was performed on parts of the embankment and appurtenant works readily available and visible for inspection by the inspection team at the time of the inspection. Such parts and appurtenant works included the upstream slope, crest, downstream slope, abutments and toes, outlet works, and spillway.

On the date of this limited visual inspection, there may or may not have appeared to be any immediate threat to the safety of the dam, however no assurance can be made regarding the dam's condition after this date. Subsequent adverse weather and other factors may affect the dam's condition.

IV. Limitations of Findings and Recommendations

The inspection is based only on visible features/areas of the dam on the day of inspection. The inspection does not entail detailed stability, hydrologic, hydraulic, or seismic investigations. This inspection is not a formal phase I or phase II dam safety inspection and does not include a review or evaluation from each specialist of an inspection team, such as a geologists, civil, geotechnical, structural, or hydraulics engineer. The owner should verify the findings of this report and take corrective actions. The owner may submit to the State alternative corrective actions that are certified by a licensed professional engineer in the State of Hawaii experienced in the design and construction of dams. This inspection does not relieve the owner/operator from their responsibility to conduct routine inspections, maintenance, repairs, modifications, monitoring, documentation, and/or investigative studies.

V. Inspection Team

Organization

U.S. Army Corps of Engineers
 State of Hawaii, Dept. of Land and Natural Resources
 National Resource Conservation Service

Name

Mr. Troy Cosgrove
 Mr. Carty Chang
 Mr. Sherman White

VI. Owner's Representatives Present

Mr. Kaeo Duarte, Kamehameha Schools
 Ms. Kapu Smith, Kamehameha Schools
 Mr. Jim Lodl, Kamehameha Schools

VII. Summary Report Team

Organization

U.S. Army Corps of Engineers

 State of Hawaii, Dept. of Land and Natural Resources

Name

Mr. Derek Chow
 Mr. Joseph Koester
 Ms. Denise Manuel
 Mr. Edwin Matsuda

VIII. Dam Type

The dam is an earthen embankment.

IX. Dam Classification

The current hazard classification of this dam is: High

Based on available data, this classification is believed to still be applicable.

Hazard Potential Classification based on the following:

Category	Loss of Life	Economic Loss
Low	None Expected	Minimal (undeveloped to occasional structures or agriculture)
Significant	Few (No Urban development and no more than a small number of inhabitable structures)	Appreciable (Notable agriculture, industry or structures)
High	More than a few	Extensive community, industry or agriculture.

Based on inventoried storage and height data, the size classification of the dam is: Small

Size Classification based on the following:

Category	Storage (Acre-Feet)	Height (feet)
Small	< 1000	< 40
Intermediate	> 1000 and < 50,000	> 40 and < 100
Large	> 50,000	> 100

X. Summary of Inspection:

Condition Rating Criteria: The conditional terms in this report are used to generally described the conditions below. Inspections, monitoring, and additional investigations are considered to be incidental to all condition ratings.

Satisfactory	Expected to fulfill intended function.
Fair	Expected to fulfill intended function, but maintenance is recommended.
Poor	May not fulfill intended function; maintenance or repairs are necessary.
Unsatisfactory	Is not expected to fulfill intended function; repair, replacement, or modification is necessary.
Unknown	Not visible, not accessible, not inspected, or unable to determine the condition rating based on the observation taken.

A. General appearance:

The reservoir and dam features were easily recognizable. The overall embankment appeared to be maintained.

Modifications / Improvements: There were no signs of any recent modifications. Based on topography, no offsite drainage expected.

Based on staff personnel, this reservoir has no incident history.

Findings and Corrective Actions:

- a. The Owner shall maintain documentations including Construction plans, specifications, improvements, modifications, Operations and Maintenance Manuals and routine inspection logs for this dam facility.
- b. An EAP is required for High Hazard Dams. Submit an updated EAP for this facility.
- c. Routine inspection logs were not inspected.
- d. Dam owners shall provide for routine inspection of the dam.
- e. Access to site appears to be satisfactory.
- f. Submit current Operations and Maintenance Manual or Procedures for this dam / reservoir facility.
- g. Submit Site or Facility Map of this Dam which identifies the location of major features including outlet works controls and conduits.
- h. Emergency Alarms / Monitors: There were no alarms or monitors observed on this reservoir.
- i. Power / Communication: There were no communication systems observed on this reservoir. There were no utility or power poles visible nearby.

B. Access / Security:

Access to the dam was accomplished via a private roadway.
Access requires a 4 wheel drive vehicle.

Access to the dam is via locked gates.

C. Inflow Works:

The inflow works were not observed. However, according to staff personnel, there is 1 inlet feeding the reservoir.

The intake or inlets have the ability to be shut off or diverted away from the reservoir during periods of heavy rains. This is done manually.

Findings and Corrective Actions:

- a. The intake works were not inspected.
- b. The intake works were not tested.

D. Reservoir

The reservoir level during the inspection was unknown, but was stated to be within normal range. Typically the spillway is always flowing

Findings and Corrective Actions:

- a. The reservoir was not inspected.
- b. A staff gage was not observed at the reservoir. Provide some method of quantifying the water level within the reservoir.

E. Upstream Slope (Fair)

The upstream slope was roughly 1V to 1H (Vertical / Horizontal).

Dumped rock slope protection was observed at the toe of the slope. Vegetation was observed growing between the rocks.

Erosions were not observed.

Cracks were not observed.

Sinkholes were not observed.

The upstream slope was visible, however some cut vegetation remained on slope.

Findings and Corrective Actions:

- a. The upstream slope appeared to be in fair to poor condition and requires corrective action.
- b. Slope protection needs maintenance or repair. Description: Remove cut vegetation and restore low grass to limit any erosion.

F. Crest: (Satisfactory)

The dam crest was approximately 15 feet wide.

There was a dirt access road on top of the crest that appeared to be well utilized.

The crest of the dam was in good condition and well maintained.

Findings and Corrective Actions:

- a. The dam crest appeared to be in satisfactory condition, no corrective actions are required at this time.
- b. Access along the crest was satisfactory.

G. Downstream Slope: (Poor)

The downstream slope was in poor condition and not visible due to heavy vegetation.

The slope was very steep, around 1V to 0.5H.

There was no access to the downstream slope or toe.

There was no slope protection observed on the downstream slope.

Erosion was not observed on the downstream slope, however the slope was not entirely visible.

Sinkholes were not observed on the downstream slope, however the slope was not entirely visible.

Vegetation was observed on the downstream slope. The vegetation consisted of bushes, tall grass and woody trees ranging from 6" to 2 feet in diameter.

Seepage was not observed on the downstream toe, however the slope was not entirely visible.

Findings and Corrective Actions:

- a. The downstream slope was not inspected.
- b. The downstream slope appeared to be in fair to poor condition and requires corrective action.
- c. The down stream slope was not visible due to high grass and bush vegetation. Clear high vegetation and maintain low to enable easy visual inspection.
- d. Tree(s) were observed on the downstream slope. Trees have been identified as the probably cause of piping failures, and can possibly cause severe damage to the embankment if they are uprooted during a high winds. Corrective action is required to remove the tree hazards from the dam. Acceptable remedies include removal of the tree and its root structure down to a 2" diameter and reconstructing the damaged embankment section. All repair work shall be accomplished as per the requirements of licensed geotechnical or structural engineer. Routinely monitor the damaged area for signs of settlement and seepage.
- e. The slope was very steep, around a 1V to 0.5H slope; further study is required to verify slope stability.

H. Abutments / Toe: (Poor)

The abutments and toe were not entirely visible or identifiable due to heavy vegetative growth.

Erosion along the abutment or toe was not visible due to heavy vegetation.

Findings and Corrective Actions:

- a. The abutments/toe were not inspected.
- b. The abutments/toe appeared to be in fair to poor condition and requires corrective action.
- c. The abutment/toe area was not visible due to high grass and bush vegetation. Clear high vegetation and maintain low to enable easy visual inspection.
- d. Tree(s) were observed along the abutment/toe. Trees have been identified as the probably cause of piping failures, and can possibly cause severe damage to the embankment if they are uprooted during a high winds. Corrective action is required to remove the tree hazards from the dam. Acceptable remedies include removal of the tree and its root structure down to a 2" diameter and reconstructing the damaged embankment section. All repair work shall be accomplished as per the requirements of licensed geotechnical or structural engineer. Routinely monitor the damaged area for signs of settlement and seepage.

I. Outlet Works: (Unknown)

Not inspected in detail, not tested.

Water was above the upstream intake structure and was not inspected.

The heavy vegetation should be removed and maintained low to enable easy visual inspection.

The outlet works were not observed due to heavy vegetation and steep slopes.

Findings and Corrective Actions:

- a. The outlet works were not inspected.
- b. The outlet works were not tested.
- c. The outlet works appeared to be in fair to poor condition and requires corrective action.
- d. Were not visible due to high grass and bush vegetation. Clear high vegetation and maintain low to enable easy visual inspection.
- e. Tree(s) were observed on the dam embankment. Trees have been identified as the probably cause of piping failures, and can possibly cause severe damage to the embankment if they are uprooted during a high winds. Corrective action is required to remove the tree hazards from the dam. Acceptable remedies include removal of the tree and its root structure down to a 2" diameter and reconstructing the damaged embankment section. All repair work shall be accomplished as per the requirements of licensed geotechnical or structural engineer. Routinely monitor the damaged area for signs of settlement and seepage.
- f. A road or path to the toe of the structure and outlet works should be established.

J. Spillway: (Poor/Unsatisfactory)

This spillway consisted of a masonry channel that flows into a ditch system and at high level an overflow is present. The spillway is located near the right abutment. The rough dimensions were 5 ft wide by 6 ft deep by 100 feet long. The spillway channel feeds an irrigation channel or at higher flow spills out to a downstream channel.

The spillway approach was clear. There was erosion observed near the spillway, which consisted of a deep head cut and scour. This erosion is located at the high level overflow and is severe. Further investigations should be conducted to conclude the capacity of the spillway.

Findings and Corrective Actions:

- a. The Spillway appeared to be in fair to poor condition and requires corrective action.
- b. At high flows the spillway appeared to be in unsatisfactory condition and not expected to fulfill its intended function. Urgent corrective action is required.
- c. Severe scour erosion was observed which requires maintenance and/or repair. Description: There is severe erosion in the high level overflow channel and the spillway is being undermined. This needs to be repaired because the spillway may fail. Repair will be difficult due to the change in elevation from the spillway to the downstream channel.
- d. A headcut was observed downstream of the spillway. Corrective / mitigative action is required to prevent this problem from moving upstream.
- e. Unclear if spillway is adequately sized. Spillway should pass the probable maximum flood. Verify spillway capacity and take corrective action as required.
- f. Need to repair the spillway outlet channel and may need to find an alternate way to divert water downstream.

K. Down Stream Channel: (Unknown)

The down stream channel was not investigated.

If the dam were to fail, the resulting flood wave would probably enter a tributary to Opauala Stream.

Findings and Corrective Actions:

- a. The downstream channel was not inspected.

XI. Additional Comments:

Original field inspection notes were scanned and are attached to this summary report. Included are several photos from the site visit to detail important features of the project, captioned to be self-explanatory. This reservoir is mainly feed by the inlet structure and if that structure is closed very little runoff would enter the reservoir.

Per e-mail dated 5/2/2006, 5:16 a.m. from Troy Cosgrove, USACE

Please describe vehicle access to site: with standard car or requires 4-wheel drive
Access requires 4-wheel drive vehicle.

Please describe access during rains: with standard car or requires 4-wheel drive
Access requires 4-wheel drive vehicle.

Please describe access when spillway is flowing: with standard car or requires 4-wheel drive
Access requires 4-wheel drive vehicle.

Intake Works:

Please describe the intake works – culvert/pipe or ditch/flume
As stated in the field, intake is a ditch.

Please indicate if the intake was a culvert/pipe or a ditch/flume. **Ditch**

Please describe the intake works to include, size, control and from.
Size and control unknown, not inspected. From reservoir.

If it is a ditch/flume also indicate the dimension and shape.
Size and dimension of ditch unknown, not inspected.

Comments:

Please indicate if the dam presented a safety hazard at the time of inspection.
The dam did not present a hazard at the time of inspection.

Please make comments to the owner about the vegetation and gully erosion. Should it be corrected immediately (within 6 months)?
The vegetation and gully erosion should be corrected in the next 6 months.

Also about the spillway outlet channel – would it be in their best interest to have a structural or geotechnical engineer assist them to find an alternate way to divert the water downstream?
Yes it would be in the best interest to hire a qualified engineer to assist in the diversion.

PHOTOGRAPHS

Dam ID: OA-019

Name: Opauala 02 Reservoir



Photo 1 Downstream slope, heavy vegetation.



Photo 2 Spillway ditch inlet.

Dam ID: OA-019

Name: Opaaula 02 Reservoir



Photo 3 High level spillway overflow erosion.



Photo 4 High level spillway overflow, erosion, potential failure.

Dam ID: OA-019

Name: Opaepala 02 Reservoir



Photo 5 Spillway channel looking downstream.



Photo 6 Downstream crest.

Dam ID: OA-019

Name: Opaaula 02 Reservoir



Photo 7 Upstream face of dam.



Photo 8 Dam crest.

Dam ID: OA-019

Name: Opauala 02 Reservoir



Photo 9 Reservoir overview.



Photo 10 Upstream spillway entrance.

Dam ID: OA-019

Name: Opauala 02 Reservoir



Photo 11 Spillway looking upstream.

FIELD INSPECTION SHEETS

Dam ID: OA-0019
OPAEULA 02 RESERVOIR

Vulnerability Index:
Extreme High Moderate Low
1 2 3 4

Inspection No: _____
Date: 4/4/06

STATE OF HAWAII - DLNR
DAM SAFETY INSPECTION SHEET

Inspection Type: Visual Dam Safety Inspection

Persons Present

Troy Casanova
Cathy Chang
Sherman White
Kaao Duarte
Kapu Smith
Jim Lodi

Affiliation

US Army Corps of Engineers
DLNR
NRCS
Kamehameha Schools
Kamehameha Schools
Kamehameha Schools

Phone Number

Weather Condition: ☐ Rain previous day ☐ Rainy ☐ Drizzle / Mist ☐ Cloudy/Overcast ☒ Partly Cloudy ☐ Sunny ☐ Dry

Comments: _____

1. General: (Information currently on file, update as required)

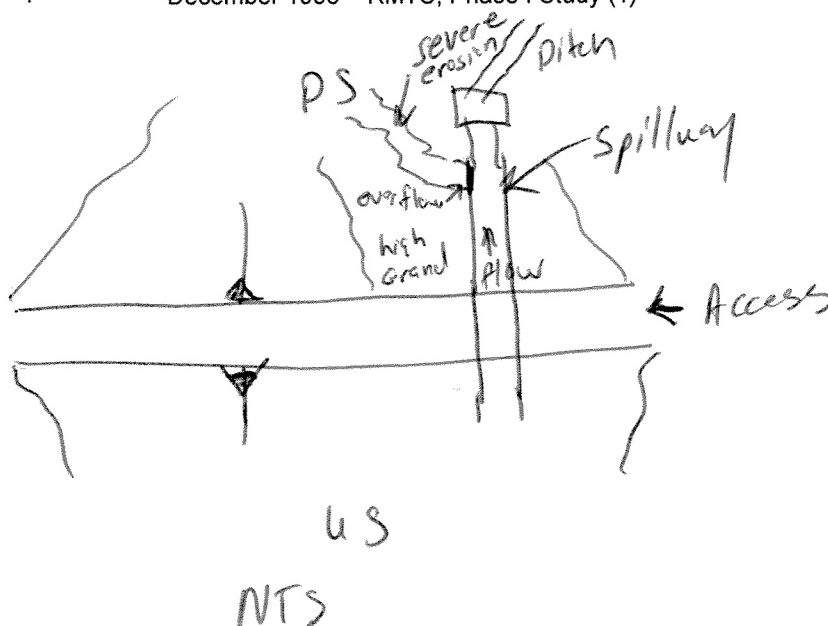
Dam/Res. Name OPAEULA 02 RESERVOIR
Owner Kamehameha Schools (C002)
Owner Contact Mr. Kaao Duarte Owner Ph. _____
Lessee _____ Lessee Ph. _____
O & M Contractor _____ O & M Ph. _____
Nearest Town HALEIWA Latitude 21.5783° (decimal)
County HONOLULU Longitude 158.0417° (decimal)
Tax Map Key(s) (1)6-2-011:001

Dam Status A: Hazard Potential H: Dam Size _____
Year Completed 1910 Dam Length 380 ft. Dam Height 38 ft.
Normal Storage 58 ac.ft. Max. Storage 75 ac.ft. Max. Surface Area 0 ac.
Drainage Area 0 mi. Spillway Type _____ Max. Spillway Q 0 cfs

Owner owns land under dam facility: _____

Emergency Action Plan on file with the Department: NO

Reports on file with the Department: December 1996 = RMTC, Phase I Study (1)



Dam ID: OA-0019
OPAEULA 02 RESERVOIR

Inspection No: _____
Date: 4/4/06

2. Questions for Owner's Rep.:

Yes No Unknown Comments

Construction Plans Available	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
Site / Facility Map	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<u>may have schematic</u>
Operation & Maintenance Manual	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
Emergency Action Plan	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<u>currently work to provide</u>
Modifications / Improvements	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
Conduct Routine Inspections	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Conduct Routine Maintenance	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Vehicle access to site	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> Not accessible <input type="checkbox"/> With Standard car <input type="checkbox"/> Requires 4-Wheel Drive
Access during heavy rains	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> Not accessible <input type="checkbox"/> With Standard car <input type="checkbox"/> Requires 4-Wheel Drive
Access when spillway is flowing	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> Not accessible <input type="checkbox"/> With Standard car <input type="checkbox"/> Requires 4-Wheel Drive
Other Studies Conducted	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/> Phase I <input type="checkbox"/> Phase II <input type="checkbox"/> Hydraulics <input type="checkbox"/> Stability <input type="checkbox"/> Hazard <input type="checkbox"/> Seismic <input checked="" type="checkbox"/> Other: <u>2004 DLNR Inspection</u>
Incident History	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> Breached <input type="checkbox"/> Overtop <input type="checkbox"/> Slide <input type="checkbox"/> Down stream Flooding <input type="checkbox"/> Other: _____
Reservoir's Current Use	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> Sediment <input checked="" type="checkbox"/> Irrigation <input type="checkbox"/> Recreation <input type="checkbox"/> Flood Control <input type="checkbox"/> Drinking Water <input type="checkbox"/> Power Generation <input type="checkbox"/> Other: _____

Findings and Corrective Actions:

- ☒ a. The Owner shall maintain documentations including Construction plans, specifications, improvements, modifications, Operations and Maintenance Manuals and routine inspection logs for this dam facility.
- ☐ b. An Emergency Action Plan (EAP) is on file with the department, submit any updates as applicable.
- ☒ c. An EAP is required for High Hazard Dams. Submit an updated EAP for this facility. 4/25/06
- ☐ d. An EAP is recommended for all dams regardless of hazard class. Submit EAP if developed for the facility.
- ☐ e. Submit narrative and additional information detailing the improvements, modifications, and/or alterations at the dam site, unless covered by approved dam permit.
- ☒ f. Routine inspection logs were not inspected.
- ☒ g. Dam owners shall provide for routine inspection of the dam.
- ☐ h. The dam did not appear to be maintained on a regular basis.
- ☒ i. Access to site appears to be satisfactory.
- ☐ j. There is no vehicular access to the dam site. Operational and emergency plans need to reflect this deficiency or access provided.
- ☐ k. Access to dam is questionable during severe weather conditions and/or spillway overflows. Operational plans and emergency plans need to reflect this deficiency or access provided.
- ☐ l. Provide a detailed narrative of the incident, responses taken, and any damages incurred. Dam owners are required to promptly advise the department of any sudden or unprecedented flood or unusual or alarming circumstance or occurrences which may adversely affect the dam or reservoir.
- ☒ m. Submit current Operations and Maintenance Manual or Procedures for this dam / reservoir facility.
- ☒ n. Submit Site or Facility Map of this Dam which identifies the location of major features including outlet works controls and conduits.
- ☐ o. _____

Additional Requirements:

The following investigative study(s) are:

Required Recommended

- | | | |
|--------------------------|--------------------------|--|
| <input type="checkbox"/> | <input type="checkbox"/> | Phase I Study |
| <input type="checkbox"/> | <input type="checkbox"/> | Phase II Study (Including <input type="checkbox"/> Seepage <input type="checkbox"/> Hydrology/Hydraulics <input type="checkbox"/> EAP) |
| <input type="checkbox"/> | <input type="checkbox"/> | Hydrology and Hydraulics (including Probable Maximum Flood and spillway capacity) |
| <input type="checkbox"/> | <input type="checkbox"/> | Stability Analysis |
| <input type="checkbox"/> | <input type="checkbox"/> | Seismic Analysis |
| <input type="checkbox"/> | <input type="checkbox"/> | Hazard Classification |
| <input type="checkbox"/> | <input type="checkbox"/> | Other: _____ |

Dam ID: OA-0019
OPAEULA 02 RESERVOIR

Inspection No: _____
Date: 4/4/06

Physical Dam Features: (Check All Applicable. Provide description of Items Observed and/or Take Photos. Indicate photo # in description.)

3. Reservoir:

Level during inspection unknown ft per _____ (gage / other)

Normal Operating Level/Range unknown ft per _____ (gage / other)

Description: gaged by eye for capacity and only filled for irrigation when needed

Typical Operation ☒ Spillway always flowing ☒ Kept within normal range ☐ Kept Empty ☐ Drained Daily ☐ Only filled by Storms

☐ Other: _____

Sinkhole in Res.: ☐ # Observed: _____ Size: _____ by _____ in. Deep ☒ Not Visible ☒ None Observed

Description: _____

Staff Gage: Description: No staff gage, regulated by eye

Findings:

- ☒ a. The reservoir was not inspected.
☐ b. The reservoir appeared to be in satisfactory condition, no corrective actions are required at this time.
☐ c. The reservoir appeared to be in fair to poor condition and requires corrective action.
☐ d. The reservoir appeared to be in unsatisfactory condition, urgent corrective action is required.

Corrective Actions:

- ☐ e. The staff gage needs maintenance and/or repair. Description: _____
☒ f. A staff gage was not observed at the reservoir. Provide some method of quantifying the water level within the reservoir.
☐ g. A sinkhole was observed in the upstream reservoir. Conduct additional investigations and monitoring to identify the cause, risk and appropriate action.
☐ h. _____

4. Intake Works Description:

☒ Number of Intakes 1

☐ Intake Culvert / Pipe

Size: _____ in. ☐ DIP ☐ Corrugated Metal ☐ PVC ☐ HDPE ☐ Concrete ☐ Other _____

Control: ☐ Gate ☐ Valve ☐ Flow can either be Shut off or Bypassed

From: ☐ Stream Diversion ☐ Pump ☐ Reservoir ☐ Other _____

☐ Ditch / Flume

Dimension: _____ (Size x Depth) Shape _____

Surface: ☐ Dirt ☐ Wood ☐ Concrete ☐ Lined w/ _____

Control: ☐ Gate ☐ Valve ☐ Flow can either be Shut off or Bypassed

From: ☐ Stream Diversion ☐ Pump ☐ Reservoir ☐ Other _____

Findings:

- ☒ a. The intake works were not inspected.
☒ b. The intake works were not tested.
☐ c. The intake works appeared to be in satisfactory condition, no corrective actions are required at this time.
☐ d. The intake works appeared to be in fair to poor condition and requires corrective action.
☐ e. The intake works appeared to be in unsatisfactory condition, urgent corrective action is required.

Corrective Actions:

- ☐ f. The intake works needs maintenance and/or repair. Description: _____
☐ g. _____

Dam ID: OA-0019
OPAEULA 02 RESERVOIR

Inspection No: _____
Date: 4/4/06

5. Upstream Slope:

(Typical Slope \pm 1V: 1H)
Slope Protection: ☐ None ☒ Dumped Rock ^{@ toe} ☐ Fitted Rip Rap ☐ Grouted Rip Rap ☐ Liner ☒ Other: revegetated
☐ Defect in Protection: Description: _____
Erosion: ☒ Loose soil w/ little vegetation ☐ Rut (<6") ☐ Gully (>6" deep) ☐ Not Visible ☒ None Observed
Description: _____
Cracks: ☐ Parallel with crest ☐ Perpendicular to crest ☐ Slide visible ☐ Not Visible ☒ None Observed
Description: _____
Sinkholes: ☐ # Observed: _____ Size: _____ and _____ Depth ☐ Not Visible ☒ None Observed
Description: _____
Vegetation: ☐ None ☒ Low Ground Cover ☐ Bushes or Tall Grass ☐ Trees # _____ ☐ <6" ☐ >6" & <20" ☐ >20"
Description: Some cut vegetation remains on slope

Findings:

- ☐ a. The upstream slope was not inspected.
- ☐ b. The upstream slope appeared to be in satisfactory condition, no corrective actions are required at this time.
- ☒ c. The upstream slope appeared to be in fair to poor condition and requires corrective action.
- ☐ d. The upstream slope appeared to be in unsatisfactory condition and not expected to fulfill its intended function. Urgent corrective action is required.

Corrective Actions:

- ☒ e. Slope protection needs maintenance or repair. Description: remove cut vegetation, restore low grass to
- ☐ f. Rut and/or Gully erosion was observed on the slope, which requires maintenance and/or repair. limit erosion
Description: _____
- ☐ g. A crack was observed on the slope, which requires further investigation to determine the underlining cause. Monitor the area and/or repair as required.
- ☐ h. A sinkhole was observed on the slope, which requires further investigation to determine the underlining cause. Repair and monitor the area.
- ☐ i. The upstream slope was not visible due to high grass and bush vegetation. Clear high vegetation and maintain low to enable easy visual inspection.
- ☐ j. Tree(s) were observed on the dam embankment. Trees have been identified as the probably cause of piping failures, and can possibly cause sever damage to the embankment if they are uprooted during a high winds. Corrective action is required to remove the tree hazards from the dam. Acceptable remedies include removal of the tree and its root structure down to a 2" diameter and reconstructing the damaged embankment section. All repair work shall be accomplished as per the requirements of licensed geotechnical or structural engineer. Routinely monitor the damaged area for signs of settlement and seepage.
- ☐ k. _____

Dam ID: OA-0019
OPAEULA 02 RESERVOIR

Inspection No: _____
Date: 4/4/06

6. Crest:

Approximate Crest Width: 315ft
Access: ☐ None ☐ Walking Path ☒ Roadway, Surface / Width / Usage: Dirt access road
Erosion: ☐ Loose soil w/ little vegetation ☐ Rut (<6") ☐ Gully (>6" deep) ☐ Not Visible ☒ None Observed
Description: _____
Cracks: ☐ Parallel with crest ☐ Perpendicular to crest ☐ Slide visible ☐ Not Visible ☒ None Observed
Description: _____
Sinkholes: ☐ _____ in. Wide x _____ in. Long x _____ in. Deep ☐ Not Visible ☒ None Observed
Description: _____
Vegetation: ☒ None ☐ Low Ground Cover ☐ Bushes or Tall Grass ☐ Trees # _____ ☐ <6" ☐ >6" & <20" ☐ >20"
Description: _____

Findings:

- ☐ a. The dam crest was not inspected.
☒ b. The dam crest appeared to be in satisfactory condition, no corrective actions are required at this time.
☐ c. The dam crest appeared to be in fair to poor condition and requires corrective action.
☐ d. The dam crest appeared to be in unsatisfactory condition and not expected to fulfill its intended function.
Urgent corrective action is required.

Corrective Actions:

- ☒ e. Access along the crest was satisfactory.
☐ f. Access along the crest was not possible. Description: _____
☐ g. Rut and/or Gully erosion was observed on the crest, which requires maintenance and/or repair.
Description: _____
☐ h. A crack was observed on the crest, which requires further investigation to determine the underlining cause.
Monitor the area and/or repair as required.
☐ i. A sinkhole was observed on the crest, which requires further investigation to determine the underlining cause.
Repair and monitor the area.
☐ j. Portions of the crest were not visible due to high grass and bush vegetation. Clear high vegetation and maintain low to enable easy visual inspection.
☐ k. Tree(s) were observed along the dam crest. Trees have been identified as the probably cause of piping failures, and can possibly cause sever damage to the embankment if they are uprooted during a high winds. Corrective action is required to remove the tree hazards from the dam. Acceptable remedies include removal of the tree and its root structure down to a 2" diameter and reconstructing the damaged embankment section. All repair work shall be accomplished as per the requirements of licensed geotechnical or structural engineer. Routinely monitor the damaged area for signs of settlement and seepage.
☐ l. _____

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7. Downstream Slope:

(Typical Slope \pm 1:0.5)

Access: ☐ lower roadway along toe ☐ roadway to outlet works ☐ walkway to outlet works ☒ None Observed

Slope Protection: ☒ None ☐ Dumped Rock ☐ Rip Rap ☐ Grouted Rip Rap ☐ Concrete

Erosion: ☐ Loose soil w/ little vegetation ☐ Rut (<6") ☐ Gully (>6" deep) ☒ Not Visible ☐ None Observed

Description: Heavy vegetation, very steep

Cracks: ☐ Parallel with crest ☐ Perpendicular to crest ☐ Slide visible ☒ Not Visible ☐ None Observed

Description: _____

Sinkholes: ☐ _____ in. Wide x _____ in. Long x _____ in. Deep ☒ Not Visible ☐ None Observed

Description: _____

Vegetation: ☐ None ☐ Low Ground Cover ☒ Bushes or Tall Grass ☒ Trees # some ☐ <6" ☒ >6" & <20" ☐ >20"

Description: Vegetation not maintain near bottom of slope

Seepage: Seep Spot Number 1

☐ Green Vegetation ☐ Wet or Muddy Ground ☐ Ponding Water ☒ Not Visible ☐ None Observed

Flowing, Description: _____

Water Clarity: ☐ Clear ☐ Some particles ☐ Muddy ☐ Other: _____

Description: _____

Seep Spot Number 2

☐ Green Vegetation ☐ Wet or Muddy Ground ☐ Ponding Water ☐ Not Visible ☐ None Observed

Flowing, Description: _____

Water Clarity: ☐ Clear ☐ Some particles ☐ Muddy ☐ Other: _____

Description: _____

Findings:

- ☒ a. The downstream slope was not inspected.
- ☐ b. The downstream slope appeared to be in satisfactory condition, no corrective actions are required at this time.
- ☒ c. The downstream slope appeared to be in fair to poor condition and requires corrective action.
- ☐ d. The downstream slope appeared to be in unsatisfactory condition and not expected to fulfill its intended function. Urgent corrective action is required.

Corrective Actions:

- ☐ e. Slope protection needs maintenance or repair. Description: _____
- ☐ f. Rut and/or Gully erosion was observed on the slope, which requires maintenance and/or repair. Description: _____
- ☐ g. A crack was observed on the slope, which requires further investigation to determine the underlining cause. Monitor the area and/or repair as required.
- ☐ h. A sinkhole was observed on the slope, which requires further investigation to determine the underlining cause. Repair and monitor the area.
- ☒ i. The down stream slope was not visible due to high grass and bush vegetation. Clear high vegetation and maintain low to enable easy visual inspection.
- ☒ g. Tree(s) were observed on the downstream slope. Trees have been identified as the probably cause of piping failures, and can possibly cause sever damage to the embankment if they are uprooted during a high winds. Corrective action is required to remove the tree hazards from the dam. Acceptable remedies include removal of the tree and its root structure down to a 2" diameter and reconstructing the damaged embankment section. All repair work shall be accomplished as per the requirements of licensed geotechnical or structural engineer. Routinely monitor the damaged area for signs of settlement and seepage.
- ☐ h. Seepage/Ponding water was observed. Monitor and conduct further investigation to locate the source of water and extent of any possible hazardous or developing condition.
- ☐ i. Seepage was observed flowing and particles were observed to be removed by the flow. Take immediate action to stop the loss of soil from the embankment. Conduct further investigation to determine the underlining cause and take corrective action. Monitor the area.
- ☒ j. The slope was very steep, around a 1 to 1 slope, further study is required to verify slope stability.
- ☐ k. _____

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8. Abutments/Toe:

Erosion: ☐ Loose soil w/ little vegetation ☐ Rut (<6") ☐ Gully (>6" deep) ☒ Not Visible ☐ None Observed
Description: Heavy vegetation and trees

Cracks: ☐ Parallel with crest ☐ Perpendicular to crest ☐ Slide visible ☒ Not Visible ☐ None Observed
Description: Heavy vegetation and trees

Vegetation: ☐ None ☐ Low Ground Cover ☒ Bushes or Tall Grass ☒ Trees # many ☒ <6" ☒ >6" & <20" ☐ >20"
Description: Toe not maintained

Seepage: Seep Spot Number 1
☐ Green Vegetation ☐ Wet or Muddy Ground ☐ Ponding Water ☒ Not Visible ☐ None Observed
Flowing, Description: heavy vegetation
Water Clarity: ☐ Clear ☐ Some particles ☐ Muddy ☐ Other: _____
Description: _____

Seep Spot Number 2
☐ Green Vegetation ☐ Wet or Muddy Ground ☐ Ponding Water ☐ Not Visible ☐ None Observed
Flowing, Description: _____
Water Clarity: ☐ Clear ☐ Some particles ☐ Muddy ☐ Other: _____
Description: _____

Findings:

- ☒ a. The abutments/toe were not inspected.
- ☐ b. The abutments/toe appeared to be in satisfactory condition, no corrective actions are required at this time.
- ☒ c. The abutments/toe appeared to be in fair to poor condition and requires corrective action.
- ☐ d. The abutments/toe appeared to be in unsatisfactory condition and not expected to fulfill its intended function. Urgent corrective action is required.

Corrective Actions:

- ☐ e. Slope protection needs maintenance or repair. Description: _____
- ☐ f. Rut and/or Gully erosion was observed, which requires maintenance and/or repair.
Description: _____
- ☐ g. A crack was observed along the abutments/near the toe, which requires further investigation to determine the underlining cause. Monitor the area and/or repair as required.
- ☒ h. The abutment/toe area was not visible due to high grass and bush vegetation. Clear high vegetation and maintain low to enable easy visual inspection.
- ☒ i. Tree(s) were observed along the abutment/toe. Trees have been identified as the probably cause of piping failures, and can possibly cause sever damage to the embankment if they are uprooted during a high winds. Corrective action is required to remove the tree hazards from the dam. Acceptable remedies include removal of the tree and its root structure down to a 2" diameter and reconstructing the damaged embankment section. All repair work shall be accomplished as per the requirements of licensed geotechnical or structural engineer. Routinely monitor the damaged area for signs of settlement and seepage.
- ☐ j. Seepage/Ponding water was observed. Monitor and conduct further investigation to locate the source of water and extent of any possible hazardous or developing condition.
- ☐ k. Seepage was observed flowing and particles were observed to be removed by the flow. Take immediate action to stop the loss of soil from the embankment. Conduct further investigation to determine the underlining cause and take corrective action. Monitor the area.
- ☐ l. _____

9. Outlet Works:

Culvert / Pipe

Type / Size: Not observed due to Heavy vegetation and tree and steep slope

Culvert: ☐ Concrete ☐ Masonry ☐ unlined earth ☐ Other _____

Pipe: ☐ DIP ☐ Corrugated Metal ☐ PVC ☐ HDPE ☐ Concrete ☐ Other _____

Control Type: ☐ Gate ☐ Valve ☐ Other _____

Location: ☐ Control on Upstream side ☐ Control on Downstream side

Seepage: ☐ Green Vegetation ☐ Wet or Muddy Ground ☐ Ponding Water ☐ Not Visible ☐ None Observed

☐ Flowing, Description: _____

Water Clarity: ☐ Clear ☐ Some particles ☐ Muddy ☐ Other: _____

Description: _____

Findings:

- ☒ a. The outlet works were not inspected.
- ☒ b. The outlet works were not tested.
- ☐ c. The outlet works appeared to be in satisfactory condition, no corrective actions are required at this time.
- ☒ d. The outlet works appeared to be in fair to poor condition and requires corrective action.
- ☐ e. The outlet works appeared to be in unsatisfactory condition and not expected to fulfill its intended function.
Urgent corrective action is required.

Corrective Actions:

- ☐ f. Seepage/Ponding water was observed. Conduct further investigation to locate the source of water and extent of any possible hazardous or developing condition.
- ☐ g. Seepage was observed flowing and particles were observed to be removed by the flow. Take immediate action to stop the loss of soil. Conduct further investigation to determine the underlining cause and take corrective action. Monitor the area. Failures caused by seepage/piping along the outlet conduit are very common and are considered to be a dangerous situation.
- ☒ h. Were not visible due to high grass and bush vegetation. Clear high vegetation and maintain low to enable easy visual inspection.
- ☐ i. _____
- ☐ j. _____

10. Spillway:

Type:

☐ None ☐ Culvert/Pipe ☒ Channel

Description: Masonry channel that flows into ditch system at high level a overflow

Dimension: 5x6 ft. Invert elevation: unknown ft. per staff gage is present.

Slope Protection: ☒ None ☐ Grass ☐ Dumped Rock ☐ Fitted Rip Rap ☐ Grouted Rip Rap ☐ Concrete

☐ Defect in Protection: Description: _____

Approach:

☒ Clear ☐ High Veg. ☐ Trees

☐ Other: _____

Erosion:

☒ Scour ☐ Gully ☐ Headcut

☐ Not Observed

☐ Other: _____

Description: Severe Severe erosion at high level over flow

Vegetation:

☒ None ☐ Low Ground Cover ☐ Bushes or Tall Grass ☐ Trees # _____ ☐ <6" ☐ >6" & <20" ☐ >20"

Description: _____

Findings:

- ☐ a. The Spillway appeared to be in satisfactory condition, no corrective actions are required at this time.
- ☒ b. The Spillway appeared to be in fair to poor condition and requires corrective action.
- ☒ c. The Spillway appeared to be in unsatisfactory condition and not expected to fulfill its intended function. Urgent corrective action is required.

@ high flows

Corrective Actions:

- ☐ d. Slope protection needs maintenance or repair. Description: _____
- ☐ e. The spillway approach was blocked. Clear approach.
- ☒ f. Severe scour erosion was observed which requires maintenance and/or repair.
- Description: Severe erosion in high level over flow, spillway is being undermined.
- ☒ g. A headcut (vertical drop in channel due to erosion) was observed downstream of the spillway. Corrective action is required to prevent this problem from moving upstream.
- ☐ h. Trees are unacceptable in the spillway channel and approach. Take corrective action to address the woody vegetation problem and repair the damaged area.
- ☒ i. Unclear if spillway is adequately sized. Spillway should pass the probable maximum flood. Verify spillway capacity and take corrective action as required.
- ☒ j. Need to repair spillway outlet channel need to find alternate way to divert water downstream

11. Down Stream Channel:

Name:

Tributary to Opaueula Stream

Downstream: ☐ Sump ☐ Open Area ☐ Un-Defined Drainage-way ☐ Defined Drainage-way

☒ Other Not inspected

Items along Stream Bank: ☐ None ☐ Road ☐ Houses ☐ Town

☒ Not Inspected

Description: _____

Findings:

- ☒ a. The downstream channel was not inspected.
- ☐ b. The downstream channel appeared to be in satisfactory condition, no corrective actions are required at this time.
- ☐ c. The downstream channel appeared to be in fair to poor condition and requires corrective action.
- ☐ d. The downstream channel appeared to be in unsatisfactory condition and not expected to fulfill its intended function. Urgent corrective action is required.

Corrective Actions:

☐ e. _____

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Additional Comments:

On the date of this limited visual inspection, there appeared to be no immediate threat to the safety of the dam. No assurance can be made regarding the dam's condition after this date. Subsequent adverse weather and other factors may affect the dam's condition.

This reservoir is mainly feed by the inlet. If closed very little runoff would enter the reservoir.

Limitations and Intent of this Dam Safety Inspection:

This Dam Safety Inspection was conducted to assess the general overall condition of the reservoir/dam, identify visible deficiencies, and recommend areas of for monitoring, additional investigative studies and corrective actions. The inspection is based only on visible features/areas of the dam on the day of inspection. This inspection is not a formal phase I or phase II dam safety inspection and does not include a review or evaluation from each specialist of an inspection team, such as a geologists, civil, geotechnical, structural, or hydraulics engineer. The owner should verify the findings of this report and take corrective actions. The owner may submit to the State alternative corrective actions that are certified by a licensed professional engineer in the State of Hawaii experienced in the design and construction of dams. This inspection does not relieve the owner/operator from their responsibility to conduct routine inspections, maintenance, repairs, modifications, monitoring, documentation, and/or investigative studies. The inspection was conducted under the authority of the Hawaii Revised Statutes Chapter 179D, and Hawaii Administrative Rules, Title 13, Chapter 190, titled "Dams and Reservoirs". Questions regarding this inspection should be forwarded to the Hawaii State Dam Safety Program; PO Box 373; Honolulu, Hawaii 96809; Ph. (808) 587-0236.

Revised: Dec. 1, 2003